

Remarks

I. Status of claims

Claim 1-20 are pending.

Claims 3, 13, and 19 have been rewritten in independent form.

Dependent claim 21 has been added.

II. Claim objections

The Examiner has objected to claims 4, 12, and 20.

Regarding claim 4, the Examiner has stated that "In line 1 of claim 4, the word "the" should be removed. The language in line 5 of claim 1 (i.e., "identifying at least one image plane coordinate"), however, provide antecedent support for the set of words "at least one image plane coordinate" that follow the definite article "the" in line 1 of claim 4. Therefore, the use of the word "the" in line 1 of claim 4 is believed to be correct.

Claims 12 and 20 have been amended in ways that address the Examiner's concerns.

III. Claim rejections under 35 U.S.C. § 112

The Examiner has rejected claims 3, 13, and 19 under 35 U.S.C. § 112, first paragraph, "as failing to comply with consistency between claims and specification disclosure." In support of this rejection, the Examiner has stated that:

Claim 3 states: "the peripheral point is located at a peripheral area of the beam spot closer to the beam axis than the other comparable peripheral areas of the beam spot." This is in contradiction with Fig. 5A of the specification, where the peripheral point (48) is located further away from the beam axis.

As to claims 13 and 19, they have the same issue as claim 3.
Note the discussion above.

Contrary to the Examiner's statement, however, claims 3, 13, and 19 are not inconsistent with the description provided in the specification. In particular, the specification explains that the Y' direction coordinate of the point 48, which is identified by the method of FIG. 2, substantially corresponds to the highest point of reflection from the target location on surface 12 (see page 6, lines 29-33). As shown in FIG. 4, the highest point of the beam spot

captured at the image plane 28 (which corresponds to the highest point of reflection from the target location on surface 12) is located at a peripheral area of the beam spot image 46 (see FIG. 5A) closer to the beam axis 23 of radiation beam 22 than other comparable peripheral areas of the beam spot because the top of the image plane 28 is tilted toward the beam axis 23 and the bottom of the image plane 28 is tilted away from the beam axis 23.

For at least this reason, the Examiner's rejection of claims 3, 13, and 19 under 35 U.S.C. § 112, first paragraph, should be withdrawn. These claims have not been rejected over prior art and therefore now are in condition for allowance.

IV. Claim rejections under 35 U.S.C. § 102

The Examiner has rejected claims 1, 2, 8, 11, 12, and 18 under 35 U.S.C. § 102(b) over Bilodeau (U.S. 5,465,152).

A. Independent claim 1

Independent claim 1 has been amended and now recites:

1. A method of topographically mapping a surface, comprising:
 - directing a radiation beam toward a target location on the surface;
 - capturing an image of a beam spot at a location in an image plane intersecting at least a portion of the radiation beam reflected from the target location on the surface;
 - identifying a peripheral point of the beam spot image;
 - determining at least one coordinate in the image plane corresponding to the identified peripheral point; and
 - assigning a relative height value to the target location based on a mapping of the at least one image plane coordinate to the relative height value.

In support of the rejection of claim 1, the Examiner has stated that:

As to claim 1, Bilodeau et al. (from this point forward will be referred to as Bilodeau) teaches a method of topographically mapping a surface (Col. 4 lines 9-13), comprising: directing a radiation beam (light source 14, which is a laser according to the specifications) toward a target location (specific x, y position, Col. 3 lines 57-58) on the surface (object, 10).

Bilodeau also teaches capturing an image of a beam spot (spot is imaged with optics, Col. 3 line 64) at a location in an image plane intersecting at least a portion of the radiation beam reflected from the target location on the surface (Fig. 4).

Also, identifying at least one image plane coordinate for a peripheral point of the beam spot image (the light sensors give the location of the beam spot. Since the peripheral point is a point within the beam spot, it is then logical to know the location of the peripheral point. Col. 3 lines 64-67; Col. 4 lines 4-6). Bilodeau further teaches assigning a relative height value (height, Col. 4 lines 4-7) to the target location based on a mapping of the at least one image plane coordinate identified for the peripheral beam spot point to the relative height value (Col. 4 lines 4-7).

Bilodeau, however, does not teach "identifying a peripheral point of the beam spot image," as now recited in claim 1. In fact, Bilodeau does not teach anything about the beam spot image except that "The sensor is selected for its ability to determine the spot image location on its surface" (col. 3, lines 65-66).

In col. 4, lines 4-10, Bilodeau teaches that:

It is well known that the image location is related, using standard optics, to the location of the light spot on the sample which, in turn, can be used to determine image height. Calibrated processing electronics (13) are used to calculate the height of the object and store the object height with its associated x,y location.

This disclosure, however, also does not teach "identifying a peripheral point of the beam spot image," as now recited in claim 1. There is no part of Bilodeau's disclosure that teaches how the sensor determines the spot image "location" (i.e., the spot image is mapped to a coordinate in the image plane).

For at least this reason, the Examiner's rejection of independent claim 1 under 35 U.S.C. § 102(b) over Bilodeau now should be withdrawn.

The Examiner has reasoned that "Since the peripheral point is a point within the beam spot, it is then logical to know the location of the peripheral point." This reasoning, however, relies on assumptions of fact that are not disclosed in Bilodeau. In particular, this reasoning assumes that the beam spot does not overlap multiple pixels of the image sensor. The Examiner's reasoning also assumes that Bilodeau's system does not determine the relative height values of surface features of an object under inspection based on image plane

coordinates corresponding to central locations of the spot images in accordance with common prior art laser triangulation approaches (see, e.g., col. 5, lines 6-8 of Roder, U.S. 6,490,368, cited by the Examiner). Nevertheless, even assuming for the purpose of argument that the beam spot does not overlap multiple pixels of the image sensor, Bilodeau does not teach anything that would have led one skilled in the art at the time of the invention to the method now recited in claim 1, which includes "identifying a peripheral point of the beam spot image."

B. Claims 2 and 8

Each of claims 2 and 8 incorporates the features of independent claim 1 and therefore is patentable over Bilodeau for at least the same reasons.

C. Claims 11 and 12

Independent claim 11 has been amended and now recites features that essentially track the pertinent features discussed above in connection with independent claim 1 and, therefore, claim 11 is patentable over Bilodeau for at least the same reasons.

Claim 12 incorporates the features of independent claim 11 and therefore is patentable over Bilodeau for at least the same reasons.

D. Claim 18

Independent claim 18 has been amended and now recites features that essentially track the pertinent features discussed above in connection with independent claim 1 and, therefore, claim 18 is patentable over Bilodeau for at least the same reasons.

V. Claim rejections under 35 U.S.C. § 103

A. Claims 4-7, 9, 10, 14-17, and 20

The Examiner has rejected claims 4-7, 9, 10, 14-17, and 20 under 35 U.S.C. § 103(a) over Bilodeau in view of Svetkoff (U.S. 5,812,269).

Each of claims 4-7, 9, and 10 incorporates the features of independent claim 1, each of claims 14-17 incorporates the features of independent claim 11, and claim 20 incorporates the features of independent claim 18.

Svetkoff does not make-up for the failure of Bilodeau to teach the features of independent claims 1, 11, and 18 discussed above. Indeed, the Examiner has cited Svetkoff merely for “applying threshold in a triangulation-based system to inspect solder joints using laser spot” (see page 5, lines 7-8 of § 7 of the Office action).

Therefore, claims 4-7, 9, 10, 14-17, and 20 are patentable over Bilodeau in view of Svetkoff for at least the same reasons explained above in connection with independent claims 1, 11, and 18.

B. Claim 10

The Examiner has rejected claim 10 under 35 U.S.C. § 103(a) over Bilodeau in view of Svetkoff and Roder (U.S. 6,490,368).

Claim 10 incorporates the features of independent claim 1. Neither Svetkoff nor Roder makes-up for the failure of Bilodeau to teach the features of independent claim 1 discussed above. Indeed, the Examiner has cited Svetkoff merely for “applying threshold in a triangulation-based system to inspect solder joints using laser spot” (see page 5, lines 7-8 in § 7 of the Office action). The Examiner has cited Roder merely for teaching “triangular mesh pattern for surface mapping” (see page 7, lines 5-6 in § 8 of the Office action).

Therefore, claim 10 is patentable over Bilodeau in view of Svetkoff and Roder for at least the same reasons explained above in connection with independent claim 1.

VI. Conclusion

For the reasons explained above, all of the pending claims are now in condition for allowance and should be allowed.

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Serial No. : 10/603,109
Filed : June 24, 2003
Page : 12 of 12

Attorney's Docket No.: 10011341-1
Amendment dated Nov. 7, 2006
Reply to Office action dated Aug. 14, 2006

Respectfully submitted,

Date: Nov. 7, 2006



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